

US-PAT-NO: 5840631

DOCUMENT-IDENTIFIER: US 5840631 A

TITLE: Method of manufacturing  
semiconductor device

----- KWIC -----

Detailed Description Text - DETX (13):

As shown in FIG. 1F, a 0.01- $\mu$ m thick titanium film 111 and a 0.05- $\mu$ m thick titanium nitride film 112 are sequentially formed on the entire surface of the silicon oxide film 108 including the through hole 110 by sputtering and reactive sputtering. A 0.2- $\mu$ m thick tungsten film 113 is formed on the titanium nitride film 112 by a blanket CVD method at a substrate temperature of 400.degree. C. and a pressure of 5,000 Pa using tungsten(VI) fluoride (WF.sub.6) gas and hydrogen gas.

Detailed Description Text - DETX (33):

Hydrogen fluoride (HF) gas as a compound having a catalysis is fed near the wafer 303 at a flow rate of 5 sccm to promote dehydration and condensation reaction of a reaction intermediate of TEOS, water, and ozone. At this time, the bubbling temperature of the TEOS solution 309 is 65.degree. C., and that of the water 311 is 30.degree. C. Reference numeral 301 denotes a heater; 302, a susceptor; 304, a dispersion head; 305, a reaction chamber; 306, an ozonizer for generating ozone from oxygen; 307, a flow controller; and 308, a constant-temperature bath.

Detailed Description Text - DETX (34):

According to the above method, the silicon oxide film 108 is formed on the surface of a silicon substrate 1 which includes the multilayered interconnection 107 formed selectively, like the structure shown in FIG. 1D. Subsequent steps of completing the manufacture of a semiconductor device are the same as in FIGS. 1C to 1F, and a description thereof will be omitted. Note that the fluorine (F) concentration in the silicon oxide film 108 formed in the third embodiment was as very low as 1.2 atomic %.

Detailed Description Text - DETX (35):

As described above, if fluorine is used as a compound having a catalysis in the third embodiment, the same effects can be obtained as in the first embodiment using phosphoric acid in terms of a decrease in OH radicals in the silicon oxide film 108 and suppression of surface roughness. Further, electrical characteristics such as a connection resistance and threshold voltage variations were measured in a two-level interconnection structure identical to that in FIG. 1F to obtain the same results as in the first embodiment.

Claims Text - CLTX (5):

2. A method according to claim 1, wherein the added compound gas consists of one acid gas comprising one of phosphorus, boron, and fluorine.

Claims Text - CLTX (20):

forming an upper wiring layer on said silicon oxide insulating film, wherein the added compound gas consists of one acid gas comprising one of phosphorus, boron, and fluorine.

Claims Text - CLTX (25):

adding a small quantity of acid gas having a catalytic effect, said acid gas comprising one of: phosphorous, boron, and fluorine, for promoting formation of silicon oxide using a main component gas comprising ozone, water vapor, and one of alkoxysilane and organosiloxane as a source gas to form a silicon oxide insulating film by a chemical vapor deposition (CVD) method on a surface of said semiconductor substrate on which said lower wiring layer is formed, said small quantity of the acid gas being small relative to the quantity of said main component gas; and

US Reference Patent Number - URPN (1):

4360393

US Reference Group - URGP (1):

4360393 19821100 Koval 148/171

US-PAT-NO: 5324686

DOCUMENT-IDENTIFIER: US 5324686 A

TITLE: Method of manufacturing  
semiconductor device using  
hydrogen as a diffusion controlling  
substance

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Detailed Description Text - DETX (4):

The present inventors have a patent covering the technical idea noted above, i.e., U.S. Pat. No. 5,173,440. The technical idea relating to the chemical state and the diffusion behavior of the impurity, which is disclosed in the previous application, is incorporated in the present specification as a reference.

Detailed Description Text - DETX (6):

In the present invention, hydrogen constitutes a typical example of a diffusion control substance serving to reduce the impurity contained in the doped glass. Hydrogen may be supplied in the form of a hydrogen molecule,  $H^{sup.+}$  ion or hydrogenated ion such as  $SiH_3^{sup.+}$ . The ionized hydrogen is bonded to an oxygen atom in the  $SiO_{sub.2}$  network in place of an impurity atom such as an arsenic atom. As a result, the impurity such as arsenic is released from the  $SiO_{sub.2}$  network so as to be put in a reduced state. Naturally, substances other than hydrogen may be used in the present invention as a diffusion control substance serving to reduce the impurity, as far as the substance can be bonded to the oxygen atom within the

SiO.sub.2 network in  
place of the impurity atom such as an arsenic atom. To be  
more specific, a  
halogen element such as fluorine and chlorine may also be  
used in the present  
invention as the diffusion control substance.

US Reference Patent Number - URPN (4):  
5173440

US Reference Group - URGP (4):  
5173440 19921000 Tsunashima et al. 437/164

US-PAT-NO: 6380040

DOCUMENT-IDENTIFIER: US 6380040 B1

TITLE: Prevention of dopant out-diffusion  
during silicidation and junction formation

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Detailed Description Text - DETX (11):

Thereafter, as depicted in FIG. 3H, a heating step is carried out in an environment saturated with a species S of the second conductivity type of impurities of doped film 371. For example, if the second conductivity type of impurities is phosphorus, species S is phosphene; if the second conductivity type of impurities is arsenic, species S is arsene. Likewise, species S may also be boron fluoride, antimony or indium depending on the second conductivity type of impurities.

Claims Text - CLTX (7):

3. The method according to claim 2, wherein the species comprises phosphene, boron fluoride, indium, antimony or arsene.

US Reference Patent Number - URPN (6):  
5478776

US Reference Patent Number - URPN (11):  
5770490

US Reference Group - URGP (6):  
5478776 19951200 Luftman et al.

US Reference Group - URGP (11):  
5770490 19980600 Frenette et al.

US-PAT-NO: 6064096

DOCUMENT-IDENTIFIER: US 6064096 A

TITLE: Semiconductor LDD device having halo  
impurity regions

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Detailed Description Text - DETX (6):

As shown in FIG. 2C, the first photoresist film 26 is removed, and a second photoresist film 28 is formed over the NMOS region of the semiconductor substrate 21. As a result, the PMOS gate structure 24b and the upper surface of the PMOS region on each side of the PMOS gate structure 24b are exposed. Preferably, ionized boron B (10-20 keV,  $1E13-5E14$  cm.sup.-2) or ionized boron fluoride BF.sub.2 (20-40 keV,  $1E13-5E14$  cm.sup.-2) is then implanted into the exposed PMOS region. The implanted B or BF.sub.2 forms p.sup.- low density (LD) regions 29 (low density P-type impurity regions) on each side of the PMOS gate structure 24b and with a portion thereof formed under the first sidewalls 25 of the PMOS gate structure 24b.

Detailed Description Text - DETX (19):

As shown in FIG. 3E, a third photoresist film 51 is formed over the NMOS region. As a result, the PMOS gate structure 44b with the first and second sidewalls 47 and 50, respectively, and the upper surface of the PMOS region on each side of the second sidewalls 50 are exposed. Preferably, ionized boron B (10-20 keV,  $1E15-3E15$  cm.sup.-2) or boron fluoride BF.sub.2 (20-40 keV,  $1E15-5E15$  cm.sup.-2) is implanted into the exposed PMOS



region. The implanted  
ionized B or BF.sub.2 forms p.sup.- source and drain (S/D)  
regions 52 (high  
density P-type source and drain impurity regions) on each  
side of the PMOS gate  
structure 44b and with a portion thereof formed under the  
second sidewalls 50  
of the PMOS gate structure 44b.

US Reference Patent Number - URPN (10):  
5770490

US Reference Group - URGP (10):  
5770490 19980600 Frenette et al.

|    | Type | L # | Hits | Search Text                   | DBs   | Time Stamp       | Comments | Error Definition | Error |
|----|------|-----|------|-------------------------------|---|------------------|----------|------------------|-------|
| 1  | BRS  | L1  | 5    | "6057216"                     | USP<br>AT;<br>US-P<br>GPU<br>B;<br>EPO;<br>JPO;<br>DER<br>WEN<br>T; | 2003/07/04 12:36 |          |                  | 0     |
| 2  | BRS  | L8  | 1    | 1 and (fluorine or fluoride)  | USP<br>AT;<br>US-P<br>GPU<br>B;<br>EPO;<br>JPO;<br>DER<br>WEN<br>T; | 2003/07/04 12:42 |          |                  | 0     |
| 3  | BRS  | L15 | 2    | "20010021575"                 | USP<br>AT;<br>US-P<br>GPU<br>B;<br>EPO;<br>JPO;<br>DER<br>WEN<br>T; | 2003/07/04 12:39 |          |                  | 0     |
| 4  | BRS  | L22 | 0    | 15 and (fluorine or fluoride) | USP<br>AT;<br>US-P<br>GPU<br>B;<br>EPO;<br>JPO;<br>DER<br>WEN<br>T; | 2003/07/04 12:39 |          |                  | 0     |
| 5  | BRS  | L29 | 4    | "5946580"                     | USP<br>AT;<br>US-P<br>GPU<br>B;<br>EPO;<br>JPO;<br>DER<br>WEN<br>T; | 2003/07/04 12:40 |          |                  | 0     |
| 6  | BRS  | L36 | 32   | "5902125"                     | USP<br>AT;<br>US-P<br>GPU<br>B;<br>EPO;<br>JPO;<br>DER<br>WEN<br>T; | 2003/07/04 12:40 |          |                  | 0     |
| 7  | BRS  | L43 | 26   | "5770490"                     | USP<br>AT;<br>US-P<br>GPU<br>B;<br>EPO;<br>JPO;<br>DER<br>WEN<br>T; | 2003/07/04 12:40 |          |                  | 0     |
| 8  | BRS  | L50 | 22   | "5478776"                     | USP<br>AT;<br>US-P<br>GPU<br>B;<br>EPO;<br>JPO;<br>DER<br>WEN<br>T; | 2003/07/04 12:40 |          |                  | 0     |
| 9  | BRS  | L57 | 5    | "5322805"                     | USP<br>AT;<br>US-P<br>GPU<br>B;<br>EPO;<br>JPO;<br>DER<br>WEN<br>T; | 2003/07/04 12:40 |          |                  | 0     |
| 10 | BRS  | L64 | 14   | "5173440"                     | USP<br>AT;<br>US-P<br>GPU<br>B;<br>EPO;<br>JPO;<br>DER<br>WEN<br>T; | 2003/07/04 12:40 |          |                  | 0     |

|    | Type | L #  | Hits | Search Text  | DBs   | Time Stamp       | Comments | Error Definition | Error |
|----|------|------|------|--|---|------------------|----------|------------------|-------|
| 11 | BRS  | L71  | 12   | "4619719"  | USP<br>AT;<br>US-P<br>GPU<br>B;<br>EPO;<br>JPO;<br>DER<br>WEN<br>T; | 2003/07/04 12:40 |          |                  | 0     |
| 12 | BRS  | L78  | 8    | "4605450"  | USP<br>AT;<br>US-P<br>GPU<br>B;<br>EPO;<br>JPO;<br>DER<br>WEN<br>T; | 2003/07/04 12:40 |          |                  | 0     |
| 13 | BRS  | L85  | 8    | "4360393"  | USP<br>AT;<br>US-P<br>GPU<br>B;<br>EPO;<br>JPO;<br>DER<br>WEN<br>T; | 2003/07/04 12:41 |          |                  | 0     |
| 14 | BRS  | L92  | 7    | "4236948"  | USP<br>AT;<br>US-P<br>GPU<br>B;<br>EPO;<br>JPO;<br>DER<br>WEN<br>T; | 2003/07/04 12:41 |          |                  | 0     |
| 15 | BRS  | L99  | 7    | "4206026"  | USP<br>AT;<br>US-P<br>GPU<br>B;<br>EPO;<br>JPO;<br>DER<br>WEN<br>T; | 2003/07/04 12:41 |          |                  | 0     |
| 16 | BRS  | L106 | 112  | 29 or 36 or 43 or 50 or 57 or 64 or 71   | USP<br>AT;<br>US-P<br>GPU<br>B;<br>EPO;<br>JPO;<br>DER<br>WEN<br>T; | 2003/07/04 12:41 |          |                  | 0     |
| 17 | BRS  | L113 | 134  | 29 or 36 or 43 or 50 or 57 or 64 or 71 or 78 or 85 or 92 or 99 or 106          | USP<br>AT;<br>US-P<br>GPU<br>B;<br>EPO;<br>JPO;<br>DER<br>WEN<br>T; | 2003/07/04 12:42 |          |                  | 0     |
| 18 | BRS  | L120 | 5    | 1 and (impurity or atom or substrate or semiconductor or fluorine or fluoride) | USP<br>AT;<br>US-P<br>GPU<br>B;<br>EPO;<br>JPO;<br>DER<br>WEN<br>T; | 2003/07/04 12:46 |          |                  | 0     |
| 19 | BRS  | L127 | 19   | 113 and (fluorine or fluoride)   | USP<br>AT;<br>US-P<br>GPU<br>B;<br>EPO;<br>JPO;<br>DER<br>WEN<br>T; | 2003/07/04 12:47 |          |                  | 0     |
| 20 | BRS  | L134 | 19   | 113 and (fluorine or fluoride or ("Fl.sub.2"))                                 | USP<br>AT;<br>US-P<br>GPU<br>B;<br>EPO;<br>JPO;<br>DER<br>WEN<br>T; | 2003/07/04 13:33 |          |                  | 0     |

|    | Type | L #      | Hits | Search Text   | DBs   | Time Stamp           | Comments | Error Definition | Error |
|----|------|----------|------|---|---|----------------------|----------|------------------|-------|
| 21 | BRS  | L14<br>1 | 19   | 134 and (temperature or heat or annealing or annealed or anneal or thermal or "1000" or degrees or silicon or atoms or crystal or semiconductor or substrate or interstitial) | USP<br>AT;<br>US-P<br>GPU<br>B;<br>EPO;<br>JPO;<br>DER<br>WEN<br>T; | 2003/07/0<br>4 13:05 |          |                  | 0     |
| 22 | BRS  | L14<br>8 | 18   | 141 and (solid or phase or coating or coat or coated or capping or silicate or BPSG or BSG or TEOG)   | USP<br>AT;<br>US-P<br>GPU<br>B;<br>EPO;<br>JPO;<br>DER<br>WEN<br>T; | 2003/07/0<br>4 13:08 |          |                  | 0     |
| 23 | BRS  | L15<br>5 | 15   | 148 and (glass or glassy)   | USP<br>AT;<br>US-P<br>GPU<br>B;<br>EPO;<br>JPO;<br>DER<br>WEN<br>T; | 2003/07/0<br>4 13:32 |          |                  | 0     |
| 24 | BRS  | L16<br>9 | 15   | 155 and (interstice or tissue or organ or part or relate or gap or sapce or intervenes or holes or occupy or subject)   | USP<br>AT;<br>US-P<br>GPU<br>B;<br>EPO;<br>JPO;<br>DER<br>WEN<br>T; | 2003/07/0<br>4 13:33 |          |                  | 0     |
| 25 | BRS  | L17<br>6 | 14   | "5173440"   | USP<br>AT;<br>US-P<br>GPU<br>B;<br>EPO;<br>JPO;<br>DER<br>WEN<br>T; | 2003/07/0<br>4 13:32 |          |                  | 0     |
| 26 | BRS  | L18<br>3 | 8    | 176 and (glass or glassy)   | USP<br>AT;<br>US-P<br>GPU<br>B;<br>EPO;<br>JPO;<br>DER<br>WEN<br>T; | 2003/07/0<br>4 13:32 |          |                  | 0     |
| 27 | BRS  | L19<br>0 | 2    | 183 and (fluorine or fluoride or ("Fl.sub.2"))  | USP<br>AT;<br>US-P<br>GPU<br>B;<br>EPO;<br>JPO;<br>DER<br>WEN<br>T; | 2003/07/0<br>4 13:33 |          |                  | 0     |
| 28 | BRS  | L19<br>7 | 2    | 190 and (interstice or tissue or organ or part or relate or gap or sapce or intervenes or holes or occupy or subject)   | USP<br>AT;<br>US-P<br>GPU<br>B;<br>EPO;<br>JPO;<br>DER<br>WEN<br>T; | 2003/07/0<br>4 13:33 |          |                  | 0     |

|   | Type | Hits | Search Text   | DBs  | Time Stamp          | Comments | Error Defin | Errors |
|---|------|------|---|--|---------------------|----------|-------------|--------|
| 1 | BRS  | 590  | ((("438/563") or ("438/557")).ccls.   | USPAT;<br>US-PGPUB; EPO;<br>JPO; DERWENT;            | 2003/07/03<br>17:40 |          |             | 0      |
| 2 | BRS  | 144  | ((("438/563") or ("438/557")).ccls.)<br>and (coating or coated or coat)   | USPAT;<br>US-PGPUB; EPO;<br>JPO; DERWENT;            | 2003/07/03<br>17:43 |          |             | 0      |
| 3 | BRS  | 42   | ((("438/563") or ("438/557")).ccls.)<br>and (coating or coated or coat)) and<br>(silicate or BSG or BPSG or TEOG)   | USPAT;<br>US-PGPUB; EPO;<br>JPO; DERWENT;            | 2003/07/03<br>17:42 |          |             | 0      |
| 4 | BRS  | 108  | ((("438/563") or ("438/557")).ccls.)<br>and (silicate or BSG or BPSG or<br>TEOG)) and (heating or annealing<br>or anneal or heat or thermal or  | USPAT;<br>US-PGPUB; EPO;<br>JPO; DERWENT;<br>IBM_TDB | 2003/07/03<br>17:43 |          |             | 0      |
| 5 | BRS  | 103  | ((("438/563") or ("438/557")).ccls.)<br>and (silicate or BSG or BPSG or<br>TEOG)) and (heating or annealing<br>or anneal or heat or thermal or<br>temperature)) and (boron and diffuse  | USPAT;<br>US-PGPUB; EPO;<br>JPO; DERWENT;<br>IBM_TDB | 2003/07/03<br>17:44 |          |             | 0      |
| 6 | BRS  | 56   | ((("438/563") or ("438/557")).ccls.)<br>and (silicate or BSG or BPSG or<br>TEOG)) and (heating or annealing<br>or anneal or heat or thermal or<br>temperature)) and (boron and diffuse  | USPAT;<br>US-PGPUB; EPO;<br>JPO; DERWENT;<br>IBM_TDB | 2003/07/03<br>17:44 |          |             | 0      |
| 7 | BRS  | 25   | (((((("438/563") or<br>("438/557")).ccls.) and (silicate or<br>BSG or BPSG or TEOG)) and<br>(heating or annealing or anneal or<br>heat or thermal or temperature)) and<br>(boron and diffuse or diffusion or<br>diffused)) and dopant) and (coating<br>or coated or coat)) and (crystal or<br>impurity or atom or ion or P or N or<br>junction or silicon or "1000" or<br>fluorine or "5" or angstrom or<br>(((("438/563") or ("438/557")).ccls.)<br>and (silicate or BSG or BPSG or<br>TEOG)) and (heating or annealing<br>or anneal or heat or thermal or | USPAT;<br>US-PGPUB; EPO;<br>JPO; DERWENT;<br>IBM_TDB | 2003/07/04<br>12:36 |          |             | 0      |